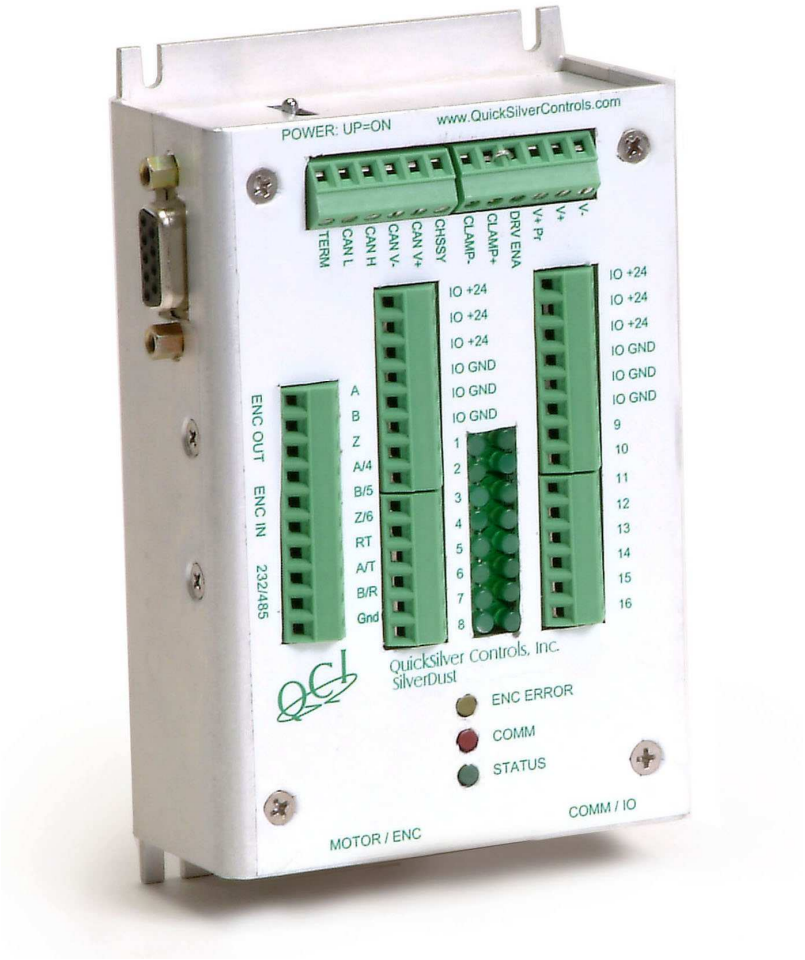
SilverDust D2 IGB Datasheet (QCI-D2-IGB)

The SilverDust D2 I-Grade with Breakout (IGB) is a servo controller/driver for QuickSilver's line of NEMA 11, 17 & 23 frame, high torque, direct drive, servomotors. The IGB is designed to servo QCI's I-Grade motors through a single cable. This single cable solution allows for easy installations and simple cable routing. The IGB has breakouts for power, communications, and I/O.



SilverDust D2 IGB
QCI-D2-IGB

NOTE: Information on the open frame, SilverDust IG (QCI-D2-IG) has been moved to datasheet QCI-DS019.

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System Overview

Point-to-Point Moves
- Relative or Absolute
- Velocity or Time Based
- S-Curve

Advanced Motion Profile Moves
- Profile Move Commands
- Register Based
  - Position/Accel/Decel/Vel
  - Modify On-the-Fly

Multi-Axis Linear Interpolation
- XYZ Coords Contained in Text File
- CANopen® used for local bus
- 1000+ Points Stored In NV Memory

Built-In Voltage Clamp
- Regenerative Braking Resistor

Input/Output
- 16 5-24V Digital I/O
  - Bi-Directional
  - Isolated
  - Set While In Motion
- 7 TTL Digital I/O
- 4 Analog Inputs (Joystick)
- Analog Output Option
- Programmable Limit Switch (PLS)
- Secondary Encoder In
- Encoder Out

Program and Data Storage
- 32K Non-Volatile Memory:
- 2000-3000 Program Lines
- User Data Examples
  - CAM Tables
  - Motion Profiles
  - Lookup Tables

Electronic Slip Clutch/Brake
- Variable Torque
- Wind/Unwind Applications

Anti-Hunt™
- Optionally use Open Loop While Holding
- No Servo Dither While At Rest

Electronic Gearing/Camming
- Follow Encoder (A/B Quadrature) or Step and Direction
- Dynamic Gear Ratios
  - Integer Ratios 32767:1 to 1:32767
  - Decimal Ratios to 7 Places
- Electronic Cam
  - Import Tables From Text File
  - Over 2500 Points
  - Multiple Tables

Communications
- RS-485/RS-232 @ 230K Baud
- ASCII,Binary,Modbus®,DMX512
- CANopen®
- Host Control While Servo in Motion

Programming Language
- Easy, Menu Driven Interface
- Command Parameter Prompts
- No Syntax Errors
- User Namable I/O and Registers

Advance PVIA™ Servo Loop
- 100:1 Inertial Mismatch
- Direct Drive Oversized Inertial Loads
  - Flywheels/Belt Drives
  - Typically Without Gearheads
- More Stable Than PID

Digital 4 Quadrant Vector Drive
- DSP Driven for Reduced Noise

Multi-Task/Multi-Thread

Compatible with QCI Motor/Encoders
- NEMA 11 Frame
  - 4000 Counts/Rev Encoder
  - Up To 9 oz-in (continuous)
- NEMA 17 Frame
  - 8000 Counts/Rev Encoder
  - Up To 43 oz-in (continuous)
  - IP50 or IP65
- NEMA 23 Frame
  - 8000 Counts/Rev Encoder
  - Up To 300 oz-in (continuous)
  - IP50 or IP65
- UL, CUL, CE

Electrical Specifications

Input Power

Voltage
+12 VDC to +48 VDC, regulated. Device must be initialized for the actual operating voltage.

Over-Voltage Protection
None available. Voltages exceeding +55 VDC will permanently damage the controller/driver electronics. The IGB includes an onboard clamp circuit. Power rating is dependent upon operation, but should be at least 10W.

Reverse Polarity Protection
Reverse polarity protection is available on the SilverDust IGB. (Note, however, if power supply is not floating, connecting the V+ input to Ground will cause this potential to be present at the communications and I/O lines, which may damage these lines or that to which they are connected.

Input Current
4 Amps maximum for any input voltage, +12 VDC to +48 VDC.

Output Power

Output/Driver Current
3.5 Amps continuous per phase *; 4.5 Amps peak per phase *.

* With Adequate Heat Sink.

Maximum Output Power
150 Watts continuous power with adequate heat dissipation.

Encoder Interface

2000 Lines = 8000 counts/revolution
Designed to work with QCI's I-Grade motor/encoders. Quadrature differential signals are employed.

Inputs & Outputs

Standard I/O
IO1-IO7

Digital Inputs
0 to +3.3 VDC. LVTTL level compatible.
Effective internal 200K ohm impedance to +3.3 V.

Digital Output Voltage
0 / +3.3 VDC.

Digital Output Current
Sinking or Sourcing
I/O 1, 4, 5, 7 outputs 4 mA MAX
I/O 2 and 3 outputs 2 mA MAX
I/O 6 outputs 8 mA MAX

I/O Over-Voltage Protection
Each I/O standard I/O line is protected with by a series over-voltage limiter. Applying voltages greater than 30 volts will permanently damage digital I/O.

Note: Encoder output signals are NOT protected.

External (Secondary) Encoder Maximum Bandwidth
Selectable by Select Encoder Filter (SEF) command. Each level must be held for a minimum of 175nS or 325nS (according to filter selection). Maximum speed is 1 million counts per second.

Analog Inputs
0 to +3.3 VDC input signal range.
10 bit ADC resolution (single).
11 bit ADC resolution (differential).
Analog inputs 1 to 4 are mapped to share digital I/O lines 4 to 7.
Each input has an effective internal 200K ohm impedance to +3.3 VDC.
Analog signals are read every servo cycle (120 µsec.) and the converted analog data is processed through a 5 ms filter to reduce noise & transients.

Extended I/O

Designated I/Os 101-116

Input Power
12 to 36 VDC. Internally isolated from processor and driver power. Current level according to load usage. Note: Power is required to read inputs as well as to drive them. A status bit is provided in Internal Status Word 2 (IS2) to detect loss of power.

Input
Isolated from processor/driver power.
0 to 5-36 VDC.
0-1V: Logic Low
2V-36V: Logic High

Output Current
Sinking Only (Set out put LOW to turn on output FET, HIGH to allow output to be pulled up)
Up to 250mA per channel continuously. If the load draws more than the specified current, the I/O line will go into current/thermal limit mode causing the FET to turn off.

I/O Over-Voltage Protection
Each I/O line will clamp at approximately 50 volts. Applying more than 40 volts may permanently damage the I/O lines.

Communications

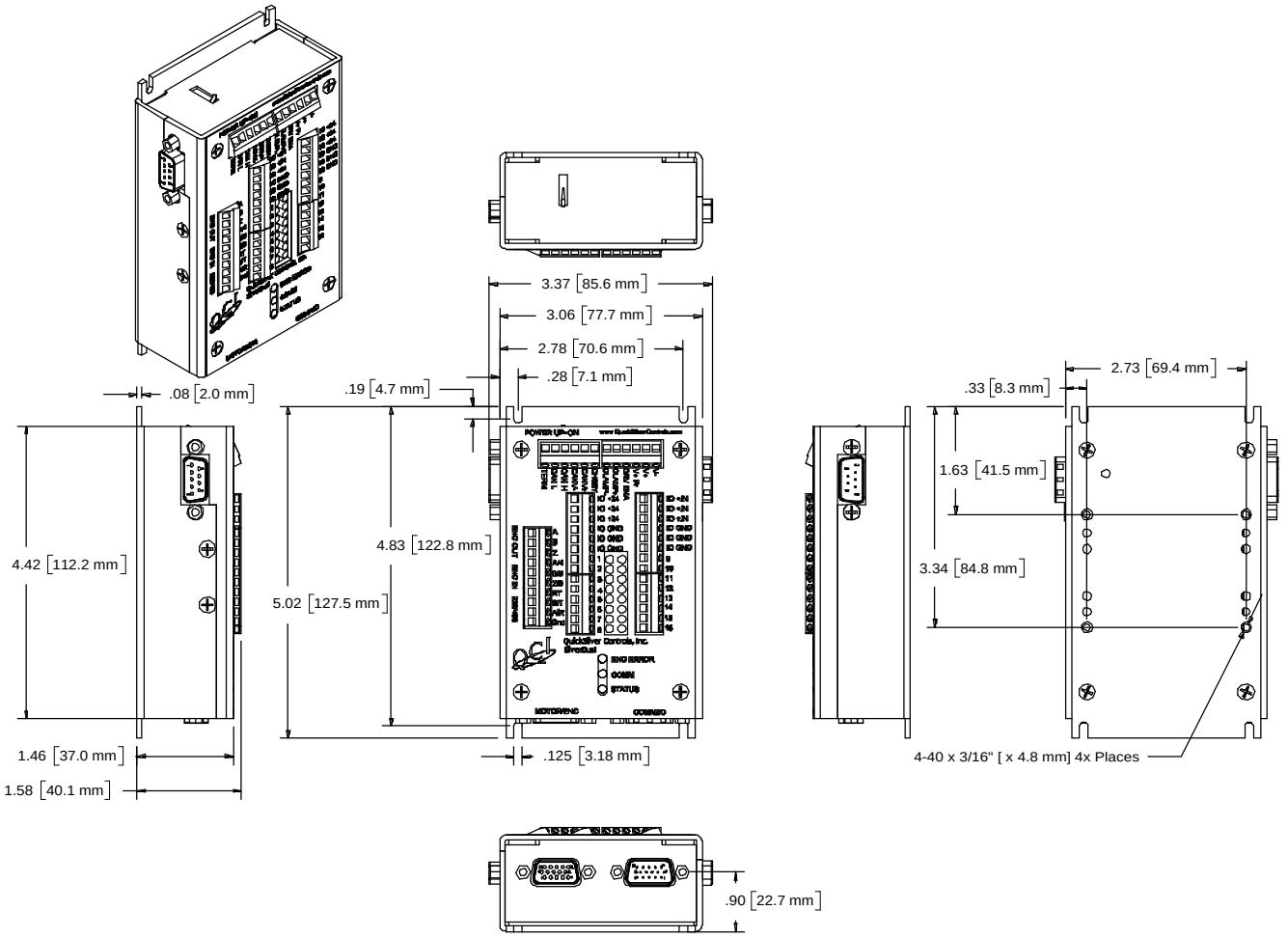
Hardware Interfaces
RS-232, RS-232 multi-drop, or RS-485 multi-drop (software selectable).

Protocols
8-bit ASCII, 9-bit binary, or Modbus®

Hardware Configuration Settings
Available Baud Rates: 2400, 4800, 9600, 19.2k, 28.8k, 57.6k, 115.2k or 230.4k
Data Bits: 8
Stop Bits: 1.5 or 2
Parity Bit: None

Controller Area Network (CAN)
Hardware: Available on all SilverDust IGB
Software: Firmware Rev 27 (QuickControl Rev 4.4)
See CANopen® User Manual for hardware and software details.

Mechanical Specifications



Environmental Specifications

Operational Temperature
-10 C to +80 C

Storage Temperature
- 40 C to +85 C

Humidity
Continuous specification is 95% RH non-condensing.

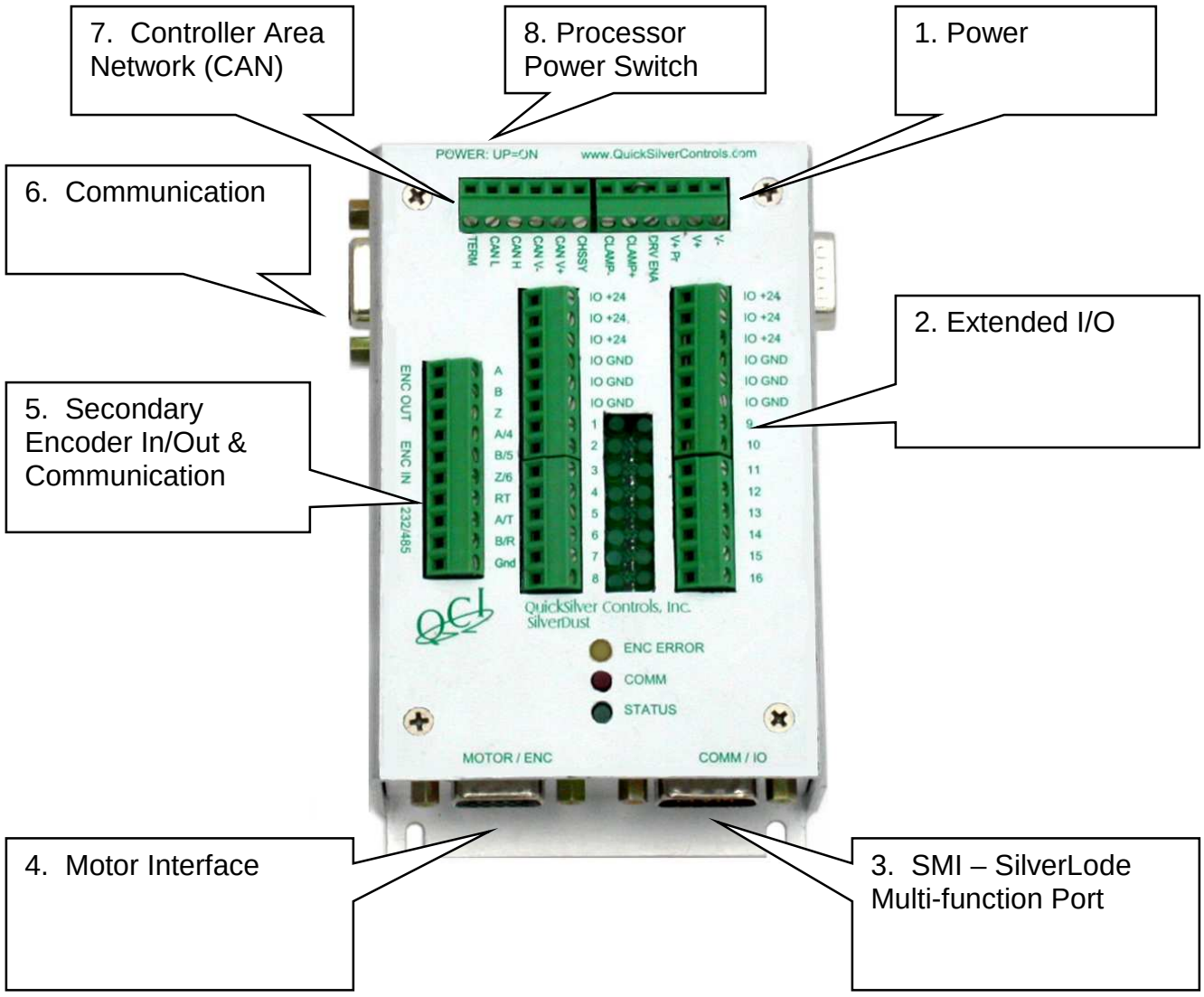
Shock
Limitation is approximately 50g/11ms.

IP Rating
IP20 with cables attached.

Connector Data

Note: For information regarding programming, please see SilverLode User manual. The SilverLode User manual is located on our website under the support section.

SilverDust IGB



1. Power

V- Power ground from the power supply.

V+ Main input power. Only voltages from 12-48 Volts are accepted. Voltages beyond the 55 Volts will permanently damage the electronic circuitry.

V+ Pr Separate processor power. Internally, processor input power is the higher of the processor power input and the main input power (diode OR'ed). This input may be used to keep the processor running while the main input power is shut off, so as to be able to continue to track the encoder signals, etc.,. No connection is needed for normal operation

DRV ENA Hardware Driver Enable. In normal operation, this pin must be high from 10-48 volts for the drive electronics to operate. The factory default ships the IGB with a jumper from CLAMP+ to DRV ENA. CLAMP+ is approximately at V+.

CLAMP+ & CLAMP– are part of the clamp circuitry, and allow for adding an external power resistor if the internal resistor is not sufficient. These two lines should be open in most applications. The internal power resistor is sized to handle regenerative power from the motor, but may allow the internal driver voltage to rise to ~50v, according to motor type and deceleration speed/torque. Smoother deceleration may be obtained by adding an additional parallel clamping resistor when using power supplies rated at less than 36v if the internal clamp voltage is being significantly elevated by the regenerated power as measured at the CLAMP+ terminal.

2. Extended I/O

The extended I/Os are fully Isolated from the main controller power and serial I/O. It is possible, however, to use the same 24v power supply to power up both the I/Os and the main power input if the power supply current is sufficient and ground isolation is not required. On a 48 volts drive system, a separate 24 volts power supply is required for the 24 Volts I/O operation.

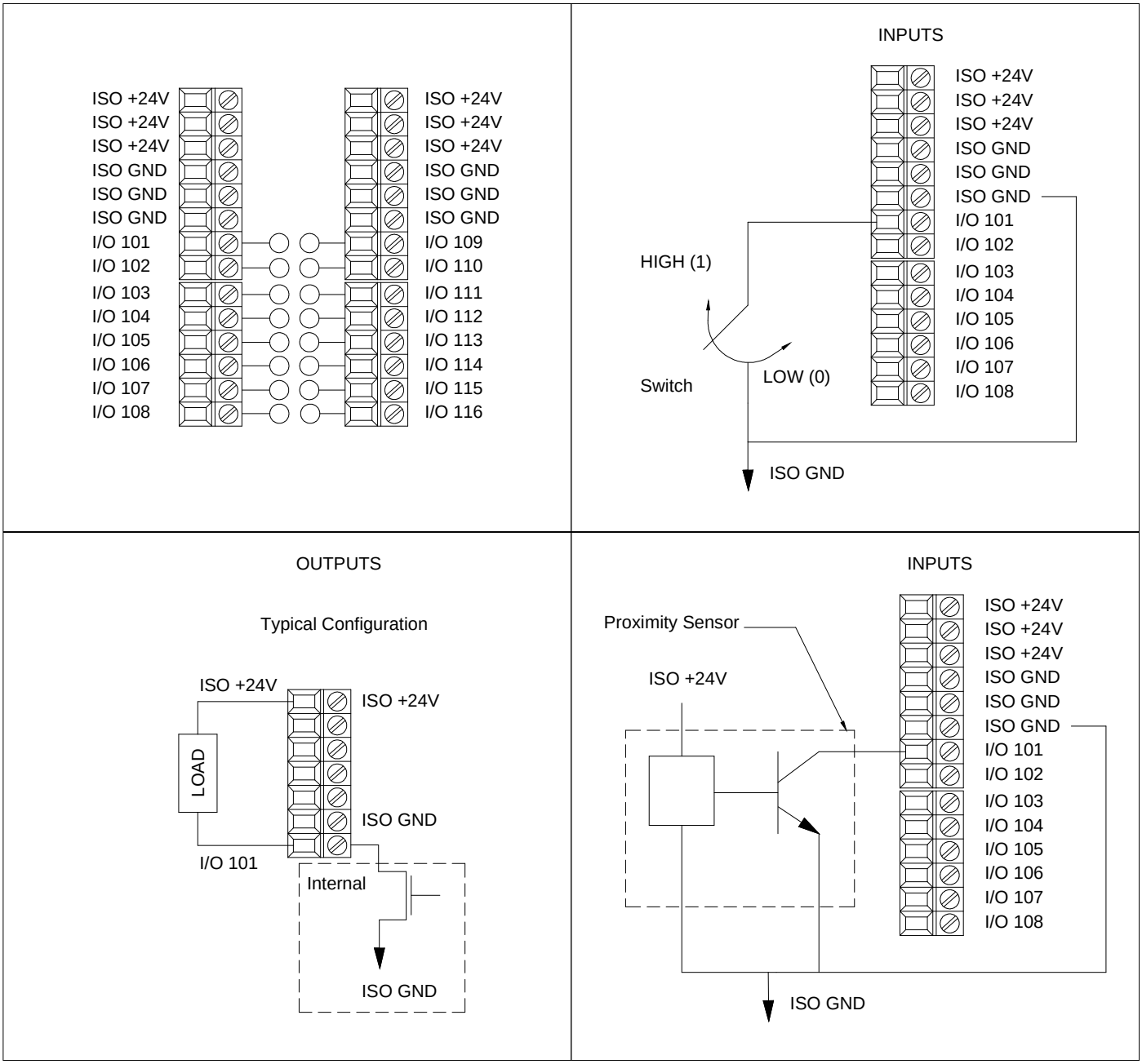
24v I/O # 1-16 as labeled on the top connectors of the IGB are mapped to the 100 bank of IO and have logical addresses of 101 – 116 in software.

I/O + 24 are the power supply inputs for the 24 Volts I/O circuitry.

I/O GND are the power grounds for the 24 Volts I/O circuitry.

I/O 101 to 116 are open drain sinking outputs. They are capable of delivering up to 250 mA per channel at 24 volts.

Note: The sinking outputs are open drain MOSFETs with an Rds of approximately 2.2 ohms. Power dissipated by the any MOSFET is $I^2 * R_{DS}$ ON. Power dissipation per channel is $P_{dissipate} = (0.250^2 * 2.2 \text{ ohms}) = 0.1375$ Watt when operated at 250mA.



Sinking Output configuration

ON or LOW = closed circuit

OFF or HIGH = open circuit

Note: This type of inputs are commonly referred as **NPN, Sinking, Open Drain, Open source, Open collector.**

Using the Extended I/Os as an Input:

All extended I/Os default to inputs.

2– 36 Volts = HIGH	LED = OFF	QuickControl Display: Green
0 to 1v LOW	LED = ON	QuickControl Display: RED

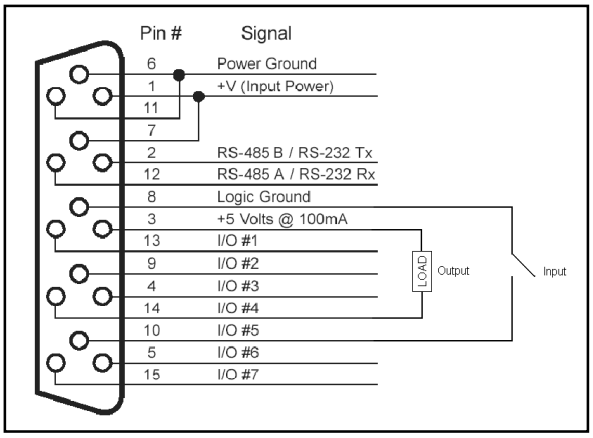
Each I/O is pulled up internally to a diode isolated +5 Volts, as well as to the associated LED through a resistor to the diode isolated +5v. An output driving one of these inputs requires a minimum of 4mA sinking current (LED + Pull-up resistor).

Commands to Use the I/Os as an Output:
Set Output Bit (SOB): Sets output HIGH (driver transistor is off)
Clear Output Bit (COB): Sets output LOW (driver transistor is on)
Configure I/O (CIO): Sets output HIGH/LOW/Tristate
Configure I/O, Immediate Mode (CII): Same as CIO, but executable from host even while a program is running.

Note: All ISO + 24 pins are connected internally.
Note: All ISO GND pins are connected internally.

See SilverLode Command Reference for more details on these commands.

3. SilverLode Multi-function Interface (SMI) Port



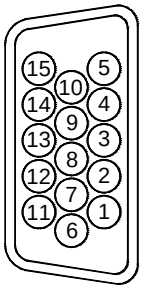
To get an additional 7 isolated 24V I/O, attach a QCI-OPTMC-24 module through a QCI-EC-SMI-02 cable.

This port provides QuickSilver's basic Power, Communication, standard I/O for backward compatibility with our previous systems. All I/O from this port are 0-3.3 Volts. Analog inputs are shared with the digital I/O. Analog inputs have 10-Bits resolution from 0-3.3 Volts. Power inputs are diode OR'ed into power inputs from section 1. Apply power from either side is OK.

Note: Encoder Inputs on section 5 uses I/O # 4, 5, and 6 listed here. If these I/O are used for electronic gearing, they are **NOT** available for general purpose I/O function.

Note: Communication lines **RS-485A / RS-232 RX**, **RS-485B / RS232 TX**, and **LOGIC GROUND** are all internally connected between the SMI port and the respective pins on the top side connectors. See sections 3, 5, and 6.

4. Motor Interface

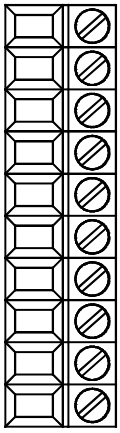


1	Motor B+
2	Chassis Ground
3	+ 5V Encoder Power
4	Encoder A -
5	Encoder B -
6	Motor A +
7	Motor B -
8	Encoder Z +
9	Encoder A +
10	Encoder Z -
11	Motor A -
12	Chassis Ground
13	Encoder B+
14	Encoder Ground
15	Motor Memory Access

QuickSilver recommends our QCI-C-D15P-D15S-nn (nn = length) cable to interface between the motor and the controller.

Note: 01, 02, 04, and 10 feet cables are standard lengths.

5. Secondary Encoder In/Out & Communication



A (Encoder Out A)
B (Encoder Out B)
Z (Encoder Out Z)
A/4 (Encoder In A)
B/5 (Encoder In B)
Z/6 (Encoder In Z)
RT (Termination)
B/T (RS 485B / RS 232 TX)
A/R (RS 485A / RS 232 RX)
Gnd (Logic Ground)

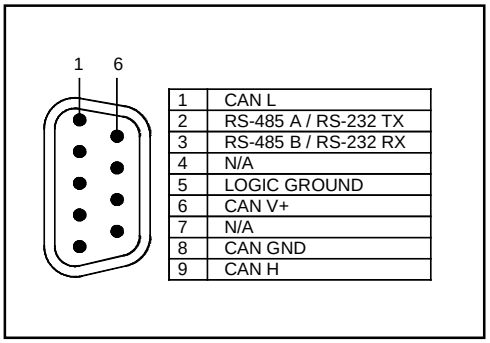
Encoder Out A, B, and Z are buffered single-ended replicates of the differential signals from the motor encoder. They are in Quadrature format, with the index in a 49/50 format.

The **Encoder In** Inputs can take Quadrature or Step and Direction format. The Index input may be configured for single pulse per revolution or 49/50 format.
Encoder In A is the Step input when in Step/Direction format.
Encoder In B is the Direction input when in Step/Direction format.

Encoder In A, B, and Z are also I/O 4, 5, and 6 respectively. If they are not used for electronic gearing, then they may be used as general I/O with 5v compliant 3.3V input and 3.3V output. These I/O are can also be used as analog inputs from 0-3.3V at 10-bit resolution.

Communications: 4 terminals are provided to allow for wiring multi-axis networks. Standard communications use three lines for either RS-232 or RS-485 (software configurable). Standard RS-485 requires termination at each the end of the network. QuickSilver has made it easier to terminate the network by providing an internal terminating resistor with one end tied to RS-485A (A/R). To terminate the network, simple connect Termination (RT) to RS-485B / RS232 (B/T) on the last unit. (Note: The Controller needs to provide a biased terminator for normal operation.)

6. Communication



1	CAN L
2	RS-485 A / RS-232 TX
3	RS-485 B / RS-232 RX
4	N/A
5	LOGIC GROUND
6	CAN V+
7	N/A
8	CAN GND
9	CAN H

A DB-9 plug and socket are provided on opposite sides of the unit. These are for communication and provide a simple means of networking the units. See Multi-Axis design section (below) for more details. Pins 2, 3 and 5 are normally used for standard PC RS-232 communications but also support RS-485. These pins are connected to the respective pins on the SMI connector as well at the respective breakout connectors. Pins 1,6,8,9 are used for the CAN communications. These pins are also connected to the respective breakout connectors.

7. Controller Area Network (CAN)

This high-speed 1-megabit bus provides a means for register and I/O sharing as well as interface to 3rd party CANOpen devices (i.e. encoders, I/O modules,…). The four CAN signals are isolated from all other signals. NOTE: CAN requires firmware rev 27 and QuickControl Rev 4.4. See SilverLode CANOpen User Manual for details.

8. Processor Power Switch

SilverDust IGB has a switch to turn on and off the power to the processor. This processor power switch is extremely useful for multi-axis programming. Note: it does not disconnect main power: The main power should be OFF before connecting or disconnecting the system.

Recommended Components

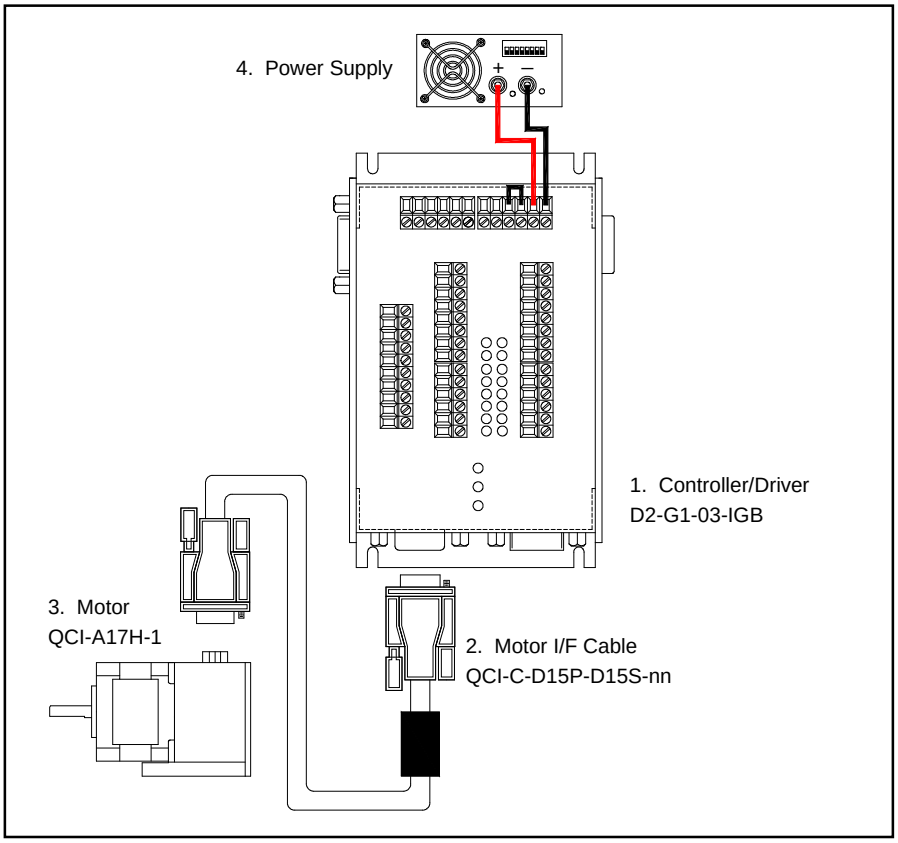
SilverDust IGB Start-Up Kit
For first time users, QCI recommends purchasing the QCI-SK-D2-IGB Start-Up Kit which includes:

- SilverDust D2 (QCI-D2-IGB) & Datasheet (QCI-DS003)
- QuickControl Software CD (QCI-QC)
- User Manual & Command Reference (QCI-SLM)
- Communication Cable (QCI-C-D9M9F-6)
- 4' DB15HD Motor I/F Cable (QCI-C-D15P-D15S-4)
- DIN Rail Bracket (QCI-DIN2)
- Start-Up Kit Setup Instructions (QCI-TD041)
- CAN to RS-232 Adapter (QCI-D9-CAN-232)

With this Start-Up kit, a power supply, and a motor/encoder, you will have everything you need to get started. See technical document QCI-TD041 on our website for details.

The system detailed below uses the QCI-SK-D2-IGB.

SilverDust IGB System



1. Controller/Driver
Standard controller/driver is a QCI-D2-IGB.

2. Motor I/F Cable
For standard systems, this D-sub type cable goes between the motor and the controller. The generic part number is QCI-C-D15P-D15S-nn. Replace the last two digits “nn” with length of cable in feet (i.e. –10 for 10 feet). Standard stock lengths are 1, 4, and 10 feet.

For IP65 system, a special IP65 cable goes in between the motor and the controller. The motors and cables are IP65, but not the controller/driver. The generic part number is QCI-C-D15P-T14S-nn. Replace the last two digits “nn” with length of cable in feet (i.e. –10 for 10 feet).

3. Motor
The SilverNugget N2 is capable of driving any 17 or 23 I-Grade motor/encoders. See the following datasheets for more information:

QCI-DS007: NEMA 17 I-Grade Motor/Encoder
QCI-DS008: NEMA 23 I-Grade Motor/Encoder

See QCI-DS017 for details on using QuickSilver's NEMA 11 frame motor with the IGB.

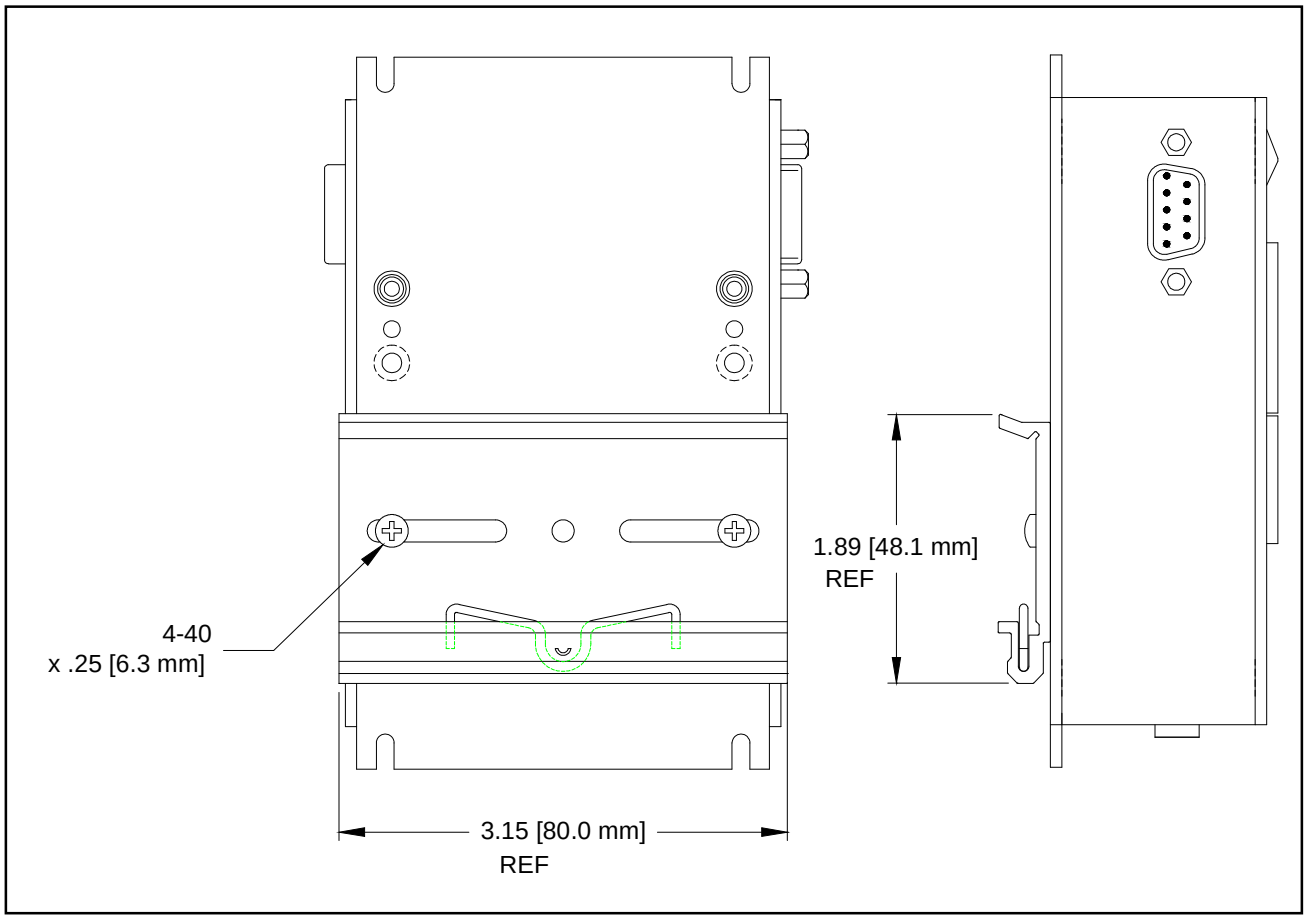
4. Power Supply
Power supply selection is motor dependent, but the following will work with all the 17 and 23 frame motors.

S-210-48 (48V, 4.4A, 210 Watt)

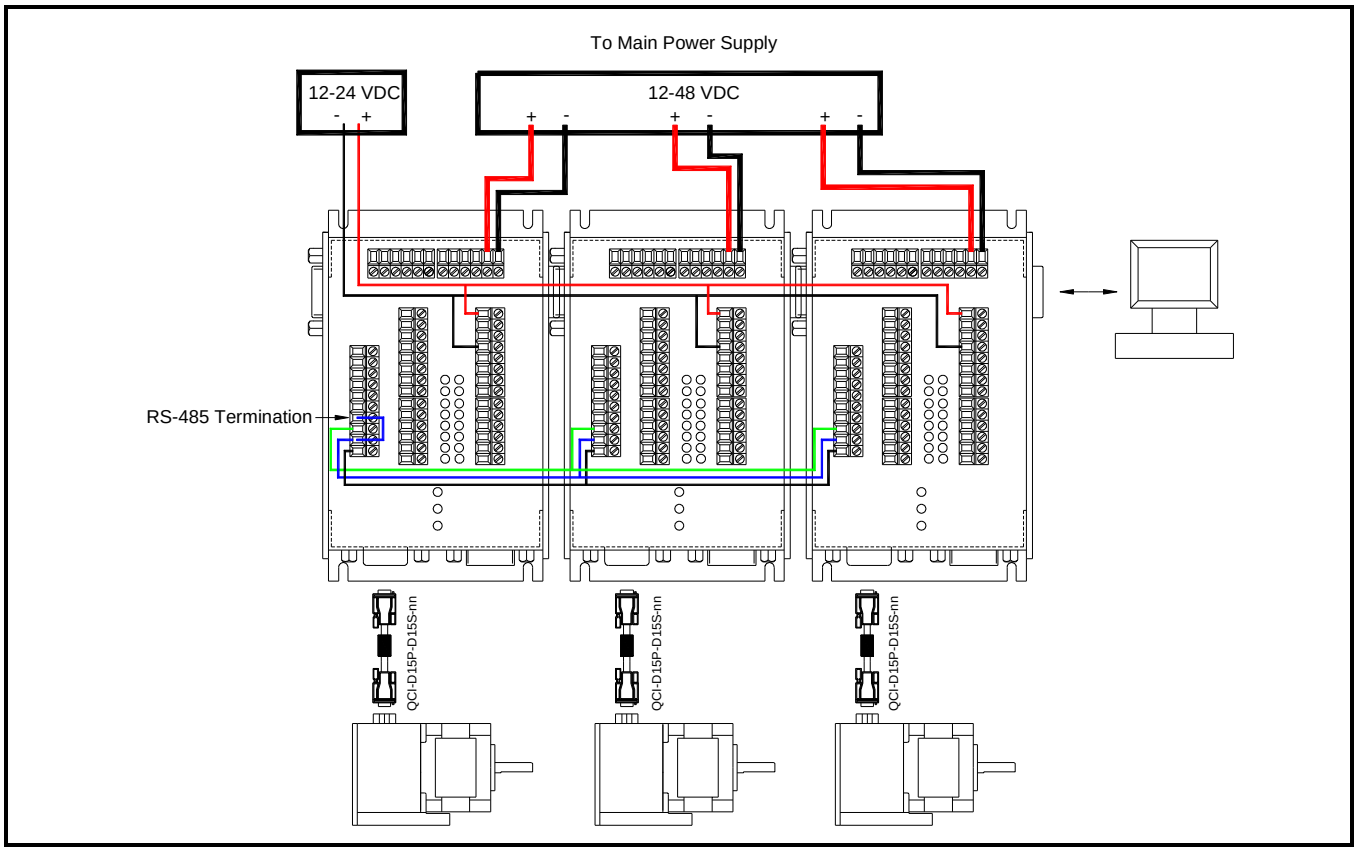
5. Din Rail Bracket – Optional (QCI-DIN2)

There are two plastic DIN-mounting clips included with every IGB. These clips are not reusable and are suitable for light industrial applications only. The DIN Rail Bracket (QCI-DIN2) is secured to the IGB using 2 screws and provides a stronger attachment to the DIN rail. See below for more details.

QCI-DIN2



Multi-Axis Design with IGB



All SilverDust IGB are designed for multi-axis operation. All units stack together on a DIN rail or wall mount as shown above. One wire jumper between Termination and RS-485B on the very last unit will terminate the RS-485 network. Users need to provide power to each unit. The communications are bussed via the 9 pin D-Sub connectors on each side of the unit.

Note: Only apply termination to the end unit when using an RS-485 network.

Note: On 12 to 24 Volts system, the I/O power supply can share from the main power supply if isolation is not needed.

Part Numbers

SilverDust™ IGB Controller/Drivers		
DRIVER	**CONTROLER**	**OPTION**
QCI-D2 - 3.5 Amp • For 23 Frame and Smaller • 3.5 Amps per Phase Continuous* • 4.5 Amp Peak • Input Power: 4A@12V-48V * Depending on heat sink (25C ambient).	**IGB** – SilverDust D2 IGB • 16 5-24V, Isolated I/O • 7 TTL Inputs or Outputs • 4 Analog Inputs (Joystick) • Analog Output Option (use QCI-BO-B1A) • RS-232 or RS-485 • ASCII, Binary, Modbus® • Encoder Output • CANopen® • Voltage Clamp And Resistor • Drive Enable • DB15HD (pin): SMI Port • DB15HD (socket): Motor I/F including motor power and encoder	**Blank** – Standard, DIN Mountable **D –** DMX512
QCI-D2	**IGB**	
This selection creates the part number: **QCI-D2-IGB**		

New Part Numbers

The part numbers have been revised

Description	Old Part Number	New Part Number
SilverDust IGB Closed Frame Servo/Controller with breakout	D2-G1-03-IGB	QCI-D2-IGB

NOTE: If old part numbers are ordered, they are shipped with firmware revision 17. Revision 17 does not include CANopen or multi-threading.

Contact Information

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